PD-0415

Quantitative evaluation of changes in FET PET performed during chemo-radiation of glioblastoma multiforme

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Purpose/Objective: Very limited information on how gliomas respond to chemo-radiation therapy (RCX) is available. Recent studies have shown the diagnostic potential of Positron Emission Tomography (PET) with O-(2-^{18}F-fluoroethyl)-l-tyrosine (FET) to discriminate glioblastoma from healthy tissue. The aim of this study was to evaluate the changes in FET uptake during RCX based on FET-PET scans.
Materials and Methods: Sixteen consecutive patients with primary glioblastoma multiforme (GBM), WHO grade IV, were treated with surgery and subsequent RCX with a standard dose of 60 Gy in 30 fractions and concurrent temozolomide (TMZ). Two FET-PET examinations, denoted FET1 and FET2, respectively, were performed once before RCX and once after approximately 20 fractions (median: 19, range 13-23). A biological tumor volume was definedin both scans (BTV1 and BTV2, respectively) using a threshold-based delineation, including tissue with a tumor-to-background ratio (TBR) of at least 1.6. Background was determined by contouring a large region contralateral to the tumor and averaging all voxels with an uptake higher than 70% of the maximum. FET2 was rigidly registered to FET1 using the CT scan in order to compare uptake parameters and spatial change of the positive volume. A maximum expansion (ME) in BTV was calculated for each patient.
Results: After approximately 40 Gy of RCX, a significantly higher background uptake of FET was observed (p =0.0025,paired t-test). The median change in TBR_{max} and TBR_{mean} were -2.2% and -1.1% (range: -27 to +16 and -11 to +12), respectively. Investigation of the spatial change in FET-uptake from the 1st to the 2nd scan revealed a median displacement of the maximum voxel (TBR_{max}) of 10.4 mm (range: 1.8-53). A significant spatial change in tumor volume is illustrated in figure 1. The margin required to include BTV at the time of FET2 ranged from 3.5 to 37 mm (median: 8.2).

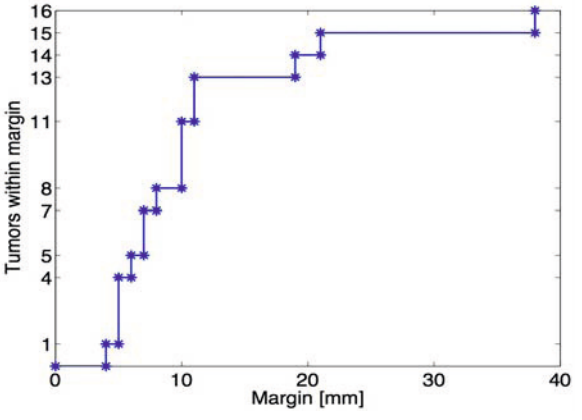

Figure 1: Y-axis: Number of tumours within margin, X-axis: Margin added to the first FET scan (mm)

Conclusions: The results show a significantly higher uptake in healthy tissue of FET during RCX, affecting the background estimate. For the 16 patients included in this study, a distinct spatial change in FET-uptake in glioblastoma during RCX was observed, assuming that the TBR of 1.6 is also usable at the time of FET2. The analysis showed a large variation of the position of the voxel with high uptake during the course of therapy.

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Robust feature auto-segmentation of head and neck cancer

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Purpose/Objective: Definition of gross tumour volume (GTV) isof great importance for radiation therapy. Definition of GTV is performed by manual contouring on image slices from computerized tomography (CT). The GTV contours are vulnerable to intra- and intercontourer variation. It is possible to reduce the variation by providing an automatic segmentation estimated from the image. The literature consists of approaches using differing algorithms and image features for the segmentation. In this study we investigated the implication of using different feature estimation parameters for segmentation to improve robustness of the approach.
Materials and Methods: The data set consisted of 40 patients. All patients had been diagnosed with hypopharynx cancer and were referred for radiation therapy. For each patient a PET/CT scan was available along with the contour of the GTV. These patients were divided into a training and test set consisting of 20 patients each. Image features were estimated using 4 different patch sizes, 3 ranges of values and 3 discretisation levels for both CT and PET. Tumour and background specific features were extracted from the training set. The training features were used to construct a tumour classifier using the adaboost algorithms. Repeated use of the training set using bootstrap methods ensured arobust classifier which was not influenced by outliers.
Using the classifier it was possible to extract both GTV and evaluate it against the manual contour of the test set using dice coefficient. The feature based segmentation was compared with the results of threshold segmentation on the PET image using a paired t-test, p-values of less than 0.05 were considered significant.
Results: Using the new feature approach it was possible to extract automatic GTV contours. The mean dice coefficient for the different feature settings varied from 0.65-0.80. The highest mean dice coefficient was achieved using a 3x3x3 patch with an absolute range of values ranging from -125to 250 HU on CT and 0 to 5 SUV on PET. There was a significant difference between the feature segmentation with the lowest and highest overlap ($p<0.01$).
Using threshold segmentation on the PET images it was possible to achieve a mean dice coefficient of 0.72. Making a paired t-test between the feature segmentation with the highest mean dice coefficient and the threshold segmentation showed a significant different ($p=0.03$).
Conclusions: It was shown that it is possible to achieve a robust segmentation using image features. There is a significant difference between different feature estimation approaches. Image features produced significantly better segmentations than conventional PET-thresholding.

PROFFERED PAPERS: CLINICAL 5: GI

OC-0417

Effect of preoperative chemoradiotherapy on recurrence pattern in esophageal tumors

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Purpose/Objective: To analyze the recurrence pattern in patients with cancer of the esophagus or gastro-esophageal junction treated with either preoperative chemoradiotherapy plus surgery (CRT + S) or surgery alone (S) within the phase II and III CROSS trials.
Materials and Methods: Relapse pattern in relation to the radiation fields was analyzed in patients from the previously published non-randomized CROSS I trial (n=54) and the subsequent randomized CROSS II trial (n=368). Multimodal treatment consisted of 5 weekly courses of Paclitaxel (50 mg/m^2) and Carboplatin (AUC = 2) combined with a concurrent radiation dose of 41.1 Gy in 23 fractions of 1.8 Gy. The radiation fields included the primary tumor, all pathologic lymph nodes and an elective lymph node area of 4 cm in craniocaudal direction from the primary tumor.
Results: Between 2001 and 2008 a total of 422 patients were included, of whom 418 were evaluable. Mean age was 60 years (36-79), histology was adenocarcinoma in 75% and squamous cell carcinoma in 23%. A total of 374 patients underwent resection, 161 (86%) of patients allocated for S and 213 (92%) for CRT+S. After a minimum follow-up of 24 months and a median follow-up of 45 months for surviving patients, the overall recurrence rate in the S-arm was 92/161 (58%) and 74/213 (35%) in the CRT+S-arm. Preoperative CRT reduced locoregional recurrences (LRR) from 34 to 14% ($p<0.0001$) and